TCAC Time Synchronization

JADS was chartered to determine the utility of Advance Distributed Simulation (ADS) for Developmental and Operational Testing in support of the acquisition process. Thus far, JADS has observed the need to accurately measure latency to assist in the evaluation of an ADS environment. Throughout the ADS test network, analysis of latency requires time synchronization of the data collection systems. During the System Integration Test (SIT), a one millisecond clock accuracy was desired. Time synchronization is not new to the Test and Evaluation (T&E) community, but it was new to the Distributed Interactive Simulation (DIS) community. The DIS community grew within the training community who requires that systems appear real to each operator or player. They were not concerned with the time synchronization between sites or players.

The DIS community has developed tools for many workstations but the preferred platforms are the Silicon Graphics Incorporated (SGI) workstations. Since most off-the-shelf DIS tools are available for or require SGI platforms, JADS purchased SGI Indy workstations to collect PDUs. These SGI workstations that make up the majority of our logging systems are not capable of supporting Global Positioning System (GPS) or Inter-Range Instramentation Group standard time-distribution signal (IRIG-B) cards due to the proprietary bus architectures used. The software alternative to the hardware solution was to use the Network Timing Protocol (NTP) to synchronize the workstations across the network.

A second logger used by JADS was the Simulation Network Analysis Project (SNAP) logger from Wright Labs. This logger runs on an Intel platform with a real time operating system. Most GPS and IRIG-B time source card vendors support the Indrustry Standard Architecture (ISA) and Protocal Control Information (PCI) bus architectures. Therefore, we synchronized the SNAP loggers by providing them an IRIG-B feed that is available in most T&E facilities.

JADS evaluated two options. A GPS receiver had been purchased and is a source of GPS and IRIG-B time. One solution was to use the NTP tool from the University of Delaware, XNTP, to derive time. This is a total software solution and required no additional hardware purchases. XNTP is free to the public. A second solution was to use an NTP card for the GPS receiver transmitting to the time server. We concluded that the proposed hardware solution would not provide any discernible accuracy improvements over the software solution.

Note: We did not evaluate the NTP hardware. This was based on the information provided by the vendor and XNTP claims.

XNTP uses a Unix daemon, xntpd, to synchronize a local workstation clock to a central time source or many time sources. Unix is not a real-time operating system and it has trouble keeping the system clock accurate. XNTP takes the local clock performance into account as it operates. The software also considers the network latencies and performance, thereby allowing the use of XNTP across local area and wide area networks. The coding or algorithms used by XNTP is beyond the scope of this paper. For additional information pertaining to the time daemon software contact the University of Delaware.

JADS uses an SGI Indy as the TCAC's time server. A GPS receiver, located in the TCAC, is connected to the serial port on the Indy. Once a second, an ASCII string containing the current time is sent to the Indy1 from the GPS receiver. The xntpd time daemon software reads the ASCII string and, if necessary, adjusts the local clock. If an adjustment is warranted, the change is gradually implemented to maintain a consistent, sequential time stamping capability ensuring that time does not go backward.

All of the other Unix Workstations (Hewlett Packard (HP), SGI, and Sun) also run the time daemon software, but they are clients to the time server, Indy1. They send a request over the Ethernet to the time server and get a response every 64 seconds. If clocks require adjustments, the changes are also gradually applied.

The XNTPD software generates statistical files on the server and client nodes. These statistics indicate how well the clocks are staying in synch. By using these statistics, we have concluded that the systems are synchronized within one millisecond.

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